UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

April 1, 2008

MEMORANDUM

SUBJECT: CSTAG Recommendations for the Lower Passaic River Site

FROM: Stephen J. Ells /s/ **Stephen J. Ells**
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TO: Alice Yeh, Remedial Project Manager
U.S. Environmental Protection Agency, Region II

Background

OSWER Directive 9285.6-08, Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites (February 12, 2002), established the Contaminated Sediments Technical Advisory Group (CSTAG) as a technical advisory group to "…monitor the progress of and provide advice regarding a small number of large, complex, or controversial contaminated sediment Superfund sites…." The main purpose of the CSTAG is to assist Regional site project managers in managing their sites in accordance with the eleven risk management principles set forth in the OSWER Directive. CSTAG membership consists of ten regional representatives, two from the Office of Research and Development, and two from the Office of Superfund Remediation and Technology Innovation (OSRTI).

Brief Description of the Site

The 17- mile portion of the Lower Passaic River (LPR) is an operable unit of the Diamond Alkali Superfund Site in Newark, New Jersey and is being addressed by a group of six partner agencies under the Lower Passaic River Restoration Project. The 17-mile portion is tidal and extends from Newark Bay upstream to Dundee Dam. Sediments in the lower eight miles of the river were identified as a source of contamination to the 17-mile portion and to Newark Bay. The risk assessments concluded that unacceptable ecological and human health risks from consumption of contaminated fish and crabs exist in the LPR. The CSTAG's review focuses on the remedial alternatives for an Early Action presented in a Focused Feasibility Study (FFS) prepared by Region II that addresses only the lower eight mile, 650-acre section of the LPR.

The 17-mile area is being studied by six entities: the EPA; the U.S. Army Corps of Engineers (Corps) and New Jersey Department of Transportation under the Water Resources Development Act; and by the U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, and New Jersey Department of Environmental Protection as Natural Resource Trustees. The Cooperating Parties Group (CPG), comprising 72 potentially responsible parties, is performing the RI/FS for the entire 17-mile study area. The goal of the RI/FS is to collect data that can be used to develop and evaluate remedial alternatives for the entire 17-mile study area that will reduce human health and ecological risks and contaminant loadings in the LPR and Newark Bay. This RI/FS is expected to be completed in 2012.

The LPR flows through densely populated and industrialized areas and ultimately into Newark Bay. The Dundee Dam is just above the head of tide at River Mile 17 and presents a hydraulic boundary. The three named tributaries to the LPR include the Saddle River, the Second River, and the Third River. Beginning in the early nineteenth century, the LPR watershed was a major center for industrial operations including cotton mills, manufactured gas plants, paper manufacturing and recycling facilities, and chemical manufacturing facilities. These facilities and adjacent municipalities discharged dioxins, petroleum hydrocarbons, polychlorinated biphenyls, pesticides, and metals to the LPR.

Although there is an authorized navigation channel through out the entire 17-mile portion, there has been little maintenance dredging since the 1940s, and none since the early 1950s. Consequently, the river has accumulated sediment in the lower eight miles, measuring up to 25 feet thick. Because the sediment accumulation occurred coincidently with unchecked chemical discharges, it contains a high mass of contamination, especially dioxins.

The Lower Passaic River is relatively narrow compared to its tidal exchange, which can account for one third of the water volume in the river at high tide. This makes the tidal surge a prominent dynamic force in the river. Data used by Region II to develop a preliminary conceptual site model suggest that tidal mixing may distribute contamination throughout the eight-mile study area. Region II believes that during the largest tidal cycles and some storm events, sediments may erode and deposit in shifting sequences, and thereby resuspend the older, more highly contaminated sediments that had been buried. Although resuspension of deeper sediments was estimated to comprise about ten percent of the total annual sediment deposition, the empirical mass balance model (EMBM) the Region developed for the site suggests that this accounts for over 95% of the dioxin and a significant portion of PCBs, pesticides, and mercury in recently deposited surface sediments. As more sediments deposit and the river approaches its pre-dredged channel depth and gradient, data suggest the river will meander within the channel. This can result in the erosion and subsequent suspension, transport and deposition of older, more highly contaminated sediments that were previously buried.

The CSTAG visited the site and met with the remedial project manager (RPM) and partner agencies from February 12 to 14, 2008. Eight stakeholder groups associated with the site were invited to present their views to the CSTAG of how the Region has applied the 11 sediment management principles in this project. Four invitees made presentations to the CSTAG including

the City of Newark, the Ironbound Community Corporation, the Passaic River Coalition, and the CPG. Written comments were submitted by the CPG (*i.e.*, de maximis, inc.), the Natural Resources Defense Council, and the Passaic River Coalition.

CSTAG Recommendations

The CSTAG makes the following recommendations concerning how the Region has addressed the 11 Principles in developing and evaluating potential early action alternatives for the lower eight miles.

Principle #1: Control Sources Early.

- In order to more reliably predict the expected effectiveness of the remedial options in reducing risks, the Region needs to evaluate more quantitatively the relative contribution of risks from dioxin and PCBs entering from upstream (*i.e.*, over Dundee Dam), from tributaries, from combined sewer outfalls (CSOs), and from instream sediments above mile eight and from Newark Bay. Therefore, CSTAG recommends that additional data be collected in order to better characterize the contaminant loads that enter the lower eight miles (*i.e.*, from upstream of the early action area) and that enter the LPR from upstream of the Dundee Dam. The significance of inputs from downstream (Newark Bay) and lateral loading (from outfalls and tributaries) should be evaluated as well. We understand that the Region has initiated new efforts to characterize external sources of contamination from tributaries, industrial outfalls, CSOs, and storm sewer outfalls (SSOs). The Region should ensure that these data are adequate to ensure that there is not an on-going source(s) that needs to be addressed before taking action in the lower eight miles, to more reliably predict post-remedial surface sediment concentrations and to more accurately estimate long-term risk reduction in the lower eight miles that may result from any early action.

- In order to further evaluate the Region's predictions resulting from the EMBM, additional information should be collected to confirm the estimate that 95% of dioxin currently accumulating in the river bottom is from resuspension and subsequent deposition of the bedded legacy sediments; *i.e.*, an internal source is driving the current risk and need for an early action. Additional recommendations on how this can be achieved are addressed under Principle #4.

Principle #2: Involve the Community Early and Often.

- CSTAG supports the Region's efforts to involve affected stakeholders. However, the Region should consider sharing site information earlier and provide more frequent updates as new data become available.

  The Region should consider hosting public information and input sessions when developing and refining treatment and disposal options for contaminated sediments [*e.g.*, confined disposal facility (CDF), off-site incinerator or high temperature thermal treatment, off-site treatment and disposal, containment in-place, etc.]. If the proposed remedy is expected to

include a CDF, discuss the potential locations with the communities and stakeholders as early as possible.

- The Region should use the information in EPA's 2005 *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* and the 2007 National Research Council report: *Sediment Dredging at Superfund Megasites Assessing the Effectiveness* to assist in communicating to stakeholders that this site presents several challenges for effective dredging and capping, and that it may take many years, if not decades, to reach remediation goals (RGs) for this site.

Principle #3: Coordinate with States, Local Governments, Tribes, and Natural Resource Trustees.

- CSTAG supports Region II's efforts to coordinate with other agencies and recommends the additional following actions.

- Clarify the roles and regulatory responsibilities of the partner agencies. For example, clarify what work is being done as part of the Corps' restoration effort under WRDA, as part of a Superfund early action or future remedial actions under EPA's CERCLA authorities, or as part of restoration efforts being undertaken by Natural Resource Trustee agencies.

- Work with the Corps to have it determine whether the commercial need for navigational dredging in any parts of the lower two miles justifies the cost to perform navigational dredging.

- Consider developing an alternative that addresses additional dredging for flood control but not for navigational purposes in the lower two miles. Region II could use this information on the differences in cost, short-term effectiveness, implementability, *etc.*, as it evaluates the cleanup options for the site.

- Work with the Corps to determine what the administrative requirements are, if any, for any alternatives that change the allowable depth of the navigation channel, including the need for Congress to deauthorize the channel or reauthorize it at a different navigational depth and length.

- Consult with the Region's water program regarding the timing of any expected CSO improvements and evaluate whether these affect the effectiveness and/or timing of any proposed remedy.

- Coordinate with local and state governments to understand what the realistic and reasonable anticipated future land uses will be for the LPR. The Region's understanding of the future land uses of the riverfront and river itself may impact the suite of remedial alternatives that are to be evaluated in the revised FFS for early action and, potentially, in the RI/FS for the 17-mile study area.

Principle #4: Develop and Refine a Conceptual Site Model that Considers Sediment Stability.

- After evaluating the briefing materials and other relevant information, the CSTAG concludes that additional sampling data are needed to support the main premise of the conceptual site model (CSM) that the entire lower eight miles is a "well mixed box."

- CSTAG questions the sufficiency of the historical data supporting EMBM predictions of on-going and expected future sediment transport that will serve as the basis for estimating post-remediation contaminant concentrations in sediment in the LPR and Newark Bay.

- CSTAG commends the Region for deciding to collect additional site data and to use it with the ECOM-SEDZLJ sediment transport model that is being developed for the LPR and Newark Bay to evaluate sediment transport and fate of legacy sediment. However, the assumptions underlying the use of the ECOM-SEDZLJ model also need to be justified. CSTAG recommends that the Region compare the model outputs between the EMBM and the updated ECOM-SEDZLJ model in order to: 1) determine if the results of the ongoing sediment transport modeling support or contradict some of the main assumptions incorporated in the EMBM; and 2) identify and reconcile any differences between the model outputs. The use of the two models will help reduce the uncertainty regarding the prediction of river dynamics.

- Compare the underlying assumptions for the bases for the CSMs as described in the FFS for the early action plan and in the longer-term RI/FS, and if necessary, align them in order to ensure that data from future sampling efforts will be useful in making all remedy decisions.

- CSTAG recommends that maps or other graphics presenting dioxin sediment chemistry sample results by location and by depth be included in the revised FFS. This would facilitate a better understanding of the nature and extent of historical and more recent site contamination throughout the eight mile area.

Principle #5: Use an Iterative Approach in a Risk-Based Framework.

- Region II should give additional consideration when revising the FFS to add one or more limited early action alternatives that address the highly contaminated erosional areas within the lower eight miles, for example, in the vicinity of the Diamond Alkali plant. The Region should perform additional analyses of all available data and/or collect additional sediment contaminant data and sediment stability data in order to adequately evaluate the potential effectiveness of these limited early actions. Due to our concern about the uncertainties associated with the data supporting the EMBM predictions, the CSTAG believes the existing information is insufficient to support the Region's conclusion that any early action addressing only a portion of the lower eight miles of the LPR would not be effective in reducing dioxin risks within the LPR or releases to Newark Bay.

- The Region should use the information being collected as part of the RI/FS for the 17-mile LPR to refine the CSM and verify the basis for the early actions proposed for the lower eight miles.

- As the long-term RI/FS continues and if additional response actions are needed for areas not addressed by an early action, consider conducting pilot studies to evaluate the effectiveness of developing technologies such as reactive caps and sediment amendments.

Principle #6: Carefully Evaluate the Assumptions and Uncertainties Associated with Site Characterization Data and Site Models.

- CSTAG believes that it may be necessary to collect more sediment samples in the lower eight miles to more adequately characterize the nature and extent of contamination.

- Under the proposed capping scenarios, in order to eliminate the potential for any increase in flooding due to remedy implementation, approximately four million cubic yards of sediment would first need to be removed. This volume is necessary in order to not raise the sediment bed elevation and to accommodate an increase water level caused by an increase in sediment bed surface friction. The increase in friction is due to the increased roughness of the sand surface compared to the existing surface of mostly fine-grained sediment and would cause a decrease in water velocity, which in turn results in a slight increase in the water surface elevation and thus increased flooding potential. Given the significant cost and time to implement such a large dredging project, the CSTAG recommends that the Region conduct a thorough re-evaluation of the engineering assumptions and calculations used to estimate the volume of sediment to be dredged. This should also include a re-evaluation of the amount of overburden-induced sediment consolidation likely to occur after adding a thick cap to areas dominated by fine-grained, low density sediments. It may be necessary to get assistance from external experts to help with this re-evaluation.

- CSTAG recommends that the Region clarify and explain the use of the contaminant data associated with the recently deposited beryllium^{7}-bearing surface sediment in the CSM-EMBM, as compared to how the contaminant data associated with the top 6 inches of sediment were used in the risk assessment. The beryllium^{7} data may not accurately represent the surface sediment (top 6-inches) dioxin concentrations across the lower eight miles of the LPR and should not be used as the primary basis to compare remedies.

- CSTAG understands that semi-permeable membrane device (SPMD) data were used in the EMBM to estimate dissolved contaminant concentrations, and then this estimate was used to estimate concentrations of contaminants on solids. This was done for the EMBM estimates of the tributary source contributions. CSTAG recommends that the Region consider the following disadvantages of using SPMDs and instead consider making direct measurements of dissolved and particulate contaminant levels.
    1. Bio-fouling can impede uptake (Lu *et al.*, 2002; Louch *et al.*, 2003);
    2. Variations in temperature can affect uptake estimates and back-calculations to water concentrations of PCBs (Lu *et al.*, 2002; Booij *et al.*, 2003);
    3. The flow-turbulence regime of the river can affect uptake estimates (Lu *et al.*, 2002);

4. The determination of a water and solids concentrations must rely on calculations based on theoretical partitioning between the dissolved and particulate form of a chemical; and
5. Investigators using SPMDs for field investigations caution against an assumption of homogenous or "well mixed" concentrations of organic contaminants in riverine surface water. This is because SPMD sampling, just like grab sampling, does not account for spatial variability without extensive data supporting the aforementioned assumption (Louch *et al.*, 2003).

- The extreme variability in the results from the resuspension evaluations (from approximately 10% to more than 95% of the total solids) using different assumptions demonstrates the high level of uncertainty associated with the EMBM. The cumulative uncertainties associated with the forecasted contaminant concentrations for the three remedial alternatives appear to be much greater than the resulting differences between the forecasted surface sediment concentrations shown in Figure 7-4 of Appendix D of the FFS. As such, the results from the EMBM should not be the only line of evidence used by the Region in deciding which remedial alternative to choose.

- CSTAG recommends that the Region provide more discussion on the uncertainties in the EMBM and clearly explain any proposed remedy in light of these uncertainties. This includes the uncertainty associated with predicted post-remedial surface sediment concentrations and estimates of contaminated sediment transport into the lower eight miles. Other uncertainties include the following:
    - Since the use of a deterministic model (a model where outputs are described using mechanistic descriptions of the processes occurring in the system of interest) may be more common in a physically complex surface water body such as this partially stratified estuary, the use of a receptor model, such as the EMBM (where concentrations measured at sources and receptors are used to identify the presence of and to quantify source contributions to receptor concentrations) needs to be more thoroughly justified.
    - The Region needs to justify or evaluate the limitations of the assumption that the concentrations of the contaminants of potential concern (COPC) will continue to decrease at the same rate as they have since about 1980. The Region needs to elaborate on the assumption that the five high resolution sediments cores represent "the mean surface concentration [and] will track the trends observed in the depositional settings reflected in the dated sediment cores" (page 7-23 of Appendix D of the FFS). The Region needs to justify the statement that the loads from "atmospheric deposition, groundwater, and New Jersey Pollutant Discharge Elimination System permitted discharges are considered negligible."
    - The Region needs to justify or clarify its assumption that the sediments in the LPR are well-mixed prior to deposition, since the LPR seems to be partially stratified. The LPR, by virtue of being partially stratified, is not a well mixed, homogenized water body. The Region stated that the LPR was an energetic waterway because the tide range was approximately half of the water depth, and therefore the water column and

suspended sediments were well mixed in all directions, *i.e.*, vertically, laterally, and longitudinally. If it was as energetic as implied, the tidal energy would break down the vertical stratification and the water column would indeed be well mixed. But because the water column retains its stratification, the tidal energy is not sufficient to overcome the potential energy barrier that the stratification represents. Since the tidal energy is not sufficient to break down the stratification, vertical gradients of salinity and any constituent (*i.e.*, sediment, contaminants) transported by the flow occur.

- Because of the meandering nature of the LPR, the vertical, lateral and longitudinal gradients in the oscillatory velocity field would result in vertical, lateral, and longitudinal gradients in suspended sediment and in other constituents such as dissolved contaminants.
- According to the FSS, the EMBM also assumes that the contaminant source profiles are independent, and as a result, only the contaminants that "distinguish the sources are characterized." The Region needs to clarify this and explain the limitations that this assumption imposes on the analysis.
- Since the EMBM focuses on suspended sediment transport, the Region needs to ensure that this transport mechanism is applicable to the key contaminants of potential concern to the LPR. This mechanism may not be appropriate to evaluate the transport of the more soluble PCB congeners.
- The EMBM assumes that if 10% of a particular contaminant comes from a source (*e.g.*, CSO's); then10% of that contaminant in the newly deposited sediments comes from that source. The CSTAG supports the Region's decision to use the ECOM-SEDZLJ model to assess the reasonableness of this assumption.
- Concentrations of the contaminants associated with the suspended solids of the tributaries were estimated by taking the product of the K_d values and the concentrations estimated using the SPMDs. This calculation assumes that the surficial sediment behind Dundee Dam and the suspended solids of the tributaries are identical in composition, including organic carbon content. This assumption is a highly doubtful assumption that is not supported by any presented data. CSTAG recommends that the K_d values be computed on an organic carbon basis in the sediment and corrections for organic carbon differences be made in the calculation for the tributaries.
- In the EMBM model, the resuspension source term for the LPR sediment was represented by average decadal concentrations (Table 4-4) or length-weighted average (LWA) concentrations of the entire contaminated sediment bed (Table 4-5). Neither of these concentrations represents the actual surface sediments that can be resuspended into the water column. From the discussions with the Region's modelers, sediments of any age could be present at the surface, and the figures showing concentrations in the surficial sediments vary widely. Thus, the wrong concentration data for the resuspension source term for the sediment were used with the EMBM. Surface-weighted average concentrations (SWACs) of some type should have been used for the eight mile stretch of the river with the EMBM.
- The Region needs to provide a more robust justification for the choice of the LWA concentration over the 1990 decadal concentration, and the Region should explain

why these concentrations are more appropriate than surface weighted average concentrations (SWACs). Region II needs to explain why the use of the LWA concentration results in a conservative estimate of "the contaminant flux associated with resuspension of historical inventory." In addition, the Region should explain why "this solution provides a tighter constraint on the external sources to the Lower Passaic River."

- The Region needs to provide better justification for the assumption in the EMBM's average decadal concentrations analysis that current day inputs from the other sources are the same as historical inputs.
- The Region needs to elaborate on the EMBM's mixed layer concept (*i.e.*, that up to 30 inches of sediment are resuspended and the resulting average adsorbed contaminant concentration represents a decadal concentration), as this is not an accurate representation of estuarine fine-grained sediment transport.

- Given the reliance on the EMBM, and the potential size and cost of an early action, CSTAG recommends an external peer review for the EMBM and the hydrodynamic and sediment transport modeling that will be used to re-evaluate the effectiveness of the alternatives considered in the revised FFS.

<u>Principle #7: Select Site-specific, Project-specific, and Sediment-specific Risk Management Approaches that will Achieve Risk-based Goals.</u>

- Projections of post-cleanup sediment concentrations appear unrealistically low. The CSTAG supports the Region's recent decision to reevaluate the level of post-remediation residual risk by incorporating more reasonable estimates of recontamination resulting from dredging and capping the lower eight miles. CSTAG also supports a more robust assessment of the potential for post-cleanup recontamination from upstream, lateral, and downstream sources, as discussed in Principle 1.

- The CSTAG recognizes the complexity of establishing risk-based cleanup goals when background concentrations present unacceptable risks, but it is not confident that the existing limited contaminant sediment concentrations above Dundee Dam are the most appropriate concentrations to use to represent background levels in the lower eight miles; additional analysis is encouraged.

<u>Principle #8: Ensure that Sediment Cleanup Levels are Clearly Tied to Risk Management Goals.</u>

- Because it will likely take many years or even decades to achieve Remedial Action Objectives, both long-term and short-term or interim remediation goals should be developed for fish and crab tissue. Because many consumers eat only crab muscle, goals based on the ingestion of just muscle should also be presented. The time to achieve these goals should be estimated for each alternative.

- As discussed under Principle #2, the risk reduction projections should be clearly and transparently communicated to affected stakeholders when describing the benefits of any

proposed early action. It is expected that fish consumption advisories in the LPR will likely remain in place indefinitely.

- The CSTAG suggests that the Region consider placing more emphasis on the potential benefits from reducing dioxin loading to Newark Bay than on achieving significant risk reduction in the LPR itself. It may also be helpful to explain the anticipated benefits of the proposed action to ecological resources (*i.e.*, beyond what was presented in the screening ecological risk assessment) in the LPR and Newark Bay.

- The risk assessment predicted residues in fishes and crabs for future conditions using BAFs derived from field data. The BAF is the ratio of the concentration of the chemical in the organism on a wet weight basis to that in the sediment on a dry weight basis. CSTAG suggests that BSAFs (ratio of the concentrations of the chemical in the organism on a lipid weight to that in the sediment on an organic carbon basis) instead of BAFs be used to predict chemical residues. Accumulation of nonpolar organic chemicals in organisms is controlled by the lipid and organic carbon phases, and thus, accounting for differences in lipid and organic carbon contents will improve the quality of the biota residues predicted for the future. CSTAG also suggests that the computed BSAFs be compared with BSAFs calculated for other sites to evaluate their reasonableness.

- The risk assessment should also estimate risks from direct contact exposure scenarios (*e.g.*, recreational user and construction worker) and develop RGs for these exposures. This information can be used to inform the community about risks due to direct contact with sediment and surface water.

Principle #9: Maximize the Effectiveness of Institutional Controls and Recognize their Limitations.

- CSTAG recommends further outreach efforts to bolster the effectiveness of the existing fish consumption advisory for fish and crabs. This could be accomplished, for example, by improving outreach through public education programs, brochures, postings in bait/tackle shops, fishing license proprietors, talks to community groups or schools, and discussions about alternatives to fishing.

- If capping is selected as part of an early action remedy, it will be important to evaluate which institutional controls will be needed to protect the integrity of the cap in light of any planned future navigational uses and construction activities in or bordering the river. It will also be important to evaluate and identify who will be responsible for ensuring that these controls remain in place over the long-term.

Principle #10: Design Remedies to Minimize Short-term Risks while Achieving Long-term Protection.

- The CSTAG supports the Region's recent decision to re-evaluate potential short-term risks from sediment resuspension and contaminant release resulting from remedy implementation. The Region should consider the recent information on increased risks caused by contaminant

releases as a result of dredging activities in Bridges *et al*., 2008 and NRC, 2007. These risks must be considered when comparing remedies in light of the short-term effectiveness and long-term effectiveness and permanence criteria.

- Estimates of contaminant releases to the water column during dredging should be compared with those generated as a result of storms, flooding and strong tides.

Principle #11: Monitor During and After Sediment Remediation to Assess and Document Remedy Effectiveness.

- Before implementing any action, the Region should clearly establish baseline conditions that will be used to evaluate remedy effectiveness. The baseline data must be of sufficient quantity and quality to allow comparisons with data collected during and after cleanup to detect differences in risk that are not related just to natural variability. This should include crab and fish tissue concentrations. Baseline and long-term monitoring should also include measures of contaminant transport to Newark Bay.

Regional Response

Please provide a written response to these recommendations within 60 days. If you have any questions or would like a clarification of any these recommendations, please call Steve Ells at (703) 603-8822.

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